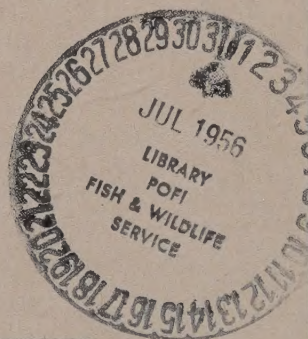


INTERNATIONAL PACIFIC SALMON
FISHERIES COMMISSION

APPOINTED UNDER A CONVENTION
BETWEEN CANADA AND THE UNITED STATES FOR THE
PROTECTION, PRESERVATION AND EXTENSION OF
THE SOCKEYE SALMON FISHERIES IN
THE FRASER RIVER SYSTEM

ANNUAL REPORT
1955



COMMISSIONERS

SENATOR THOMAS REID
ELTON B. JONES
H. R. MacMILLAN

A. J. WHITMORE
ROBERT J. SCHOETTLER
ARNIE J. SUOMELA

NEW WESTMINSTER
CANADA
1956

INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION

MEMBERS AND PERIOD OF SERVICE SINCE THE INCEPTION OF THE COMMISSION IN 1937

CANADA

William A. Found	1937-1939
A. L. Hager	1937-1948
Senator Thomas Reid	1937-
A. J. Whitmore	1939-
Olof Hanson	1948-1952
H. R. MacMillan, C.B.E., D.Sc. .	1952-

UNITED STATES

Edward W. Allen	1937-1951
B. M. Brennan	1937-1942
Charles E. Jackson	1937-1946
Fred J. Foster	1943-1947
Milo Moore	1946-1949
Albert M. Day	1947-1954
Alvin Anderson	1949-1950
Robert J. Schoettler	1951-
Elton B. Jones	1951-
Arnie J. Suomela	1954-

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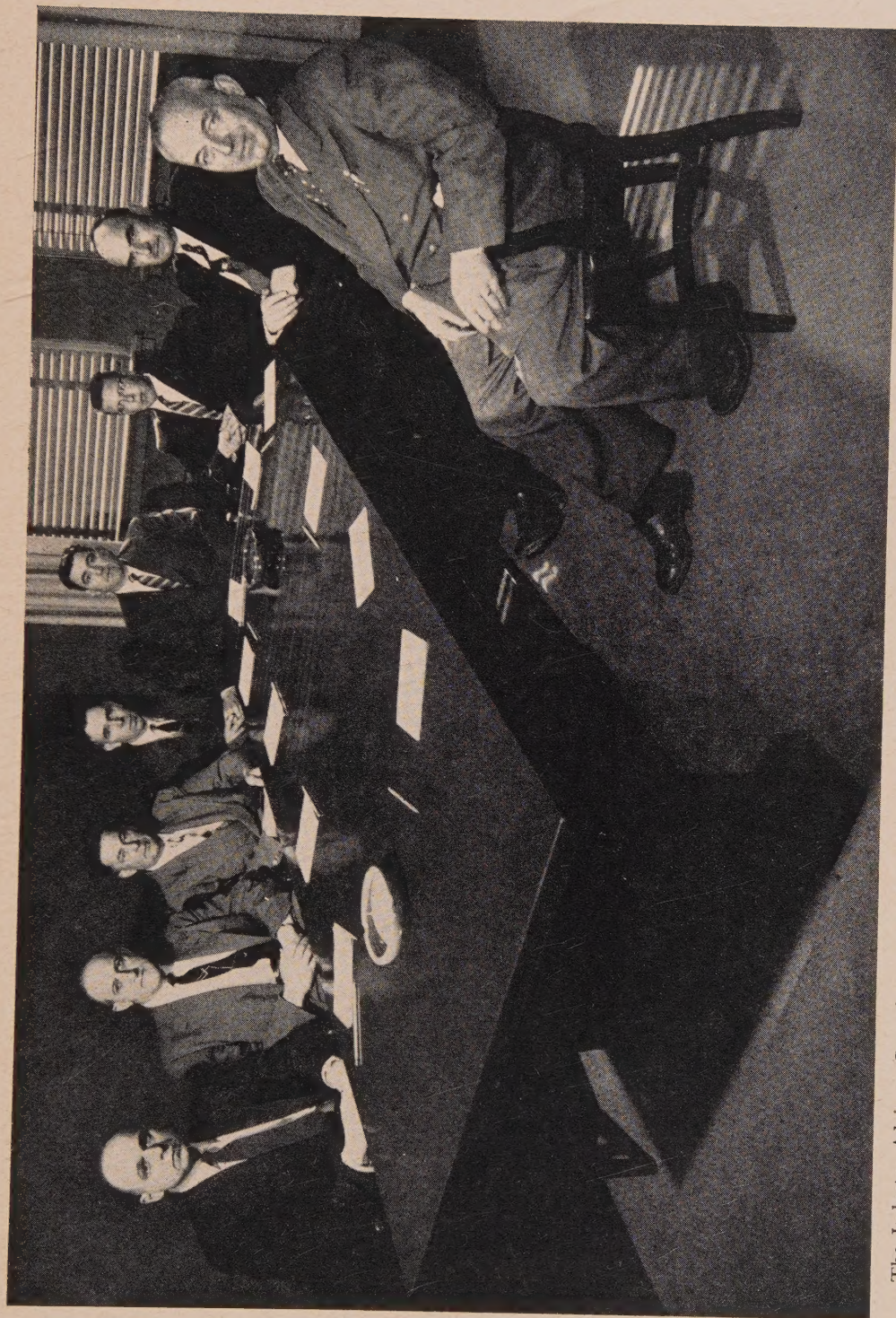
**SENATOR THOMAS REID
ELTON B. JONES
H. R. MacMILLAN**

**A. J. WHITMORE
ROBERT J. SCHOETTLER
ARNIE J. SUOMELA**

DIRECTOR OF INVESTIGATIONS

LOYD A. ROYAL

**NEW WESTMINSTER
CANADA
1956**



The Industry Advisory Committee to the International Pacific Salmon Fisheries Commission who advise with the Commission in the formulation of the annual regulations affecting Fraser River sockeye. From left: J. N. Planché, Howard Gray, Chester Carlson, Herbert North, N. Mladinich, Jerry Anderson (acting as alternate for John Brown), William Pitre and Richard Nelson. Missing are M. W. Black, Canadian sport fishermen and Peter Jenewein, Canadian gill net representative.

REPORT OF THE INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION FOR THE YEAR 1955

The Sockeye Salmon Fisheries Convention ratified by the Governments of Canada and the United States on July 28, 1937 provided for the establishment of the International Pacific Salmon Fisheries Commission and outlined as its terms of reference the protection, preservation and extension of the sockeye salmon fishery of the Fraser River system. On June 12, 1953 the International Convention for the High Seas Fisheries of the North Pacific Ocean was ratified by the Governments of the United States, Canada and Japan. This Convention provided in part that Japan should abstain from salmon fishing in the North Pacific Convention area off the Coasts of Canada and the United States of America in which commercial offshore fishing for salmon originating in the rivers of Canada and the United States of America is being or could be prosecuted. This Convention further provided that at the termination of a five-year period dated from the entry into force of the Convention continued abstention from salmon fishing by Japan would be contingent upon a reasonable compliance on the part of Canada and the United States with each of the following conditions:

(i) Evidence based upon scientific research indicates that more intensive exploitation of the stock will not provide a substantial increase in yield which can be sustained year after year.

(ii) The exploitation of the stock is limited or otherwise regulated through legal measures, by each party which is substantially engaged in its exploitation, for the purpose of maintaining or increasing its maximum sustained productivity; such limitations and regulations being in accordance with conservation programs based upon scientific research; and

(iii) The stock is the subject of extensive scientific study designed to discover whether the stock is being fully utilized and the conditions necessary for maintaining its maximum productivity.

Morphological studies and marine tagging operations, by the International Pacific Salmon Fisheries Commission, to determine the freshwater origin of sockeye salmon taken on the high seas adjacent to Juan de Fuca Strait indicate that fish of Fraser River origin comprise the bulk of the sockeye catch in this area. This is substantiated by the synchronized appearance of large numbers of maturing sockeye first off Juan de Fuca Strait and shortly thereafter off the mouth of the Fraser River, which is the only extensive sockeye-spawning stream in the general area. Fraser River sockeye are thus shown to be part of the salmon stocks governed by the provisions of the International Convention for the High Seas Fisheries of the North Pacific Ocean. It is important therefore to record that the activities of the International Pacific Salmon Fisheries Commission are such that the provisions of the North Pacific Convention as specified above are being met for Fraser River sockeye salmon.

The history of the Fraser River sockeye fishery may be divided into six distinct periods: the growth to maturity, from 1872 to 1899; the first depletion, from 1899 to 1903; the first recovery, ending in 1910; the second long period of serious depletion, beginning in 1911 and extending to 1949; and the second recovery period, beginning in 1949 and continuing to date. The second period of depletion led to the Sockeye Fisheries Convention in 1937 which provided for the creation of the International Pacific Salmon Fisheries Commission. The primary activity of the Commission was to organize a scientific staff to determine the cause of the continued low level of catch; the catch had declined from the equivalent of 2,392,895 forty-eight pound cases in 1913 to 160,531 cases in 1937. Scientific investigations from 1938 to 1942 proved that the first period of depletion from 1899 to 1903 was related to the construction of a dam on the Quesnel River, a major spawning tributary. These investigations also proved that the second period of depletion which had started in 1911 was related to an obstruction caused by railroad construction in the vicinity of Hell's Gate, a narrow pass located 135 miles up the Fraser River. The possible existence of overfishing was not disproven but it was eliminated as the *major* cause of the decline in the sockeye fishery. That decline is now estimated to have cost the fishing industry of Canada and the United States approximately one billion dollars. The serious responsibility of preserving the suitable migratory and reproductive environment as a necessary function of successful sockeye salmon fishery management was thoroughly established.

The construction of fishways at Hell's Gate was begun in 1944 and completed in 1946, the fishways being partially operative in 1945. Scientific investigations were continued in following years at Hell's Gate and the necessity of the fishways in overcoming the Hell's Gate obstruction was recorded. After the construction of the fishways not only did the percentage of the run reaching most of the spawning grounds increase but the reproductive rate of those using the fishways was apparently double that of the few fish which were able to reach their spawning grounds during the obstruction period. Completion of the fishways and removal of several abandoned dams restored the Fraser River watershed to its natural state as a sockeye reproducing area. It was possible thereafter to measure the true effect of fishing on the reproductive rate of the population.

By the terms of the Convention power was granted to the Commission in 1946 to regulate the fishery for the purpose of restoring and protecting the Fraser River sockeye population. The population was known to be far below its original maximum size, but all of the scientific evidence collected during the preceding eight years was utilized to permit a limited operation of the fishing industry during the requisite rehabilitation period. Scientific investigations were maintained to detect weaknesses in regulatory design, and to guarantee that rehabilitation would continue and that maximum production would be obtained from minimum escapement. The benefits being derived from the scientifically designed regulations and from the fishways are evident in the increased catches of the last four years. The total catch of sockeye for the four-year period from 1951 to 1954 was 18,246,000 fish compared with 6,478,000

sockeye taken in the previous four brood years of 1947-1950. The current wholesale value of the consequent increase in the pack was \$42,192,000. An example of the refinement of the regulations is the precision with which the catch is equally divided between the fishermen of Canada and the United States, as required by the Convention: In the four-year period from 1951 to 1954 Canadian fishermen took 9,157,000 of the total of 18,246,000 sockeye, or 50.2 per cent, while the United States fishermen took 9,089,000, or 49.8 per cent.

The current sockeye pack is still much less than obtained prior to the Hell's Gate disaster; the pack for the four-year period 1951-1954 represents about 56 per cent of the sockeye packed during the four-year period 1910-1913 immediately preceding the Hell's Gate obstruction. The complete restoration of the fishery to its former level, or to a maximum sustainable level, and its subsequent maintenance depends upon full scientific knowledge of the forces controlling the reproduction of the species and the establishment of the required relationship between the fishery and the escapement.

Scientific studies are continuing to the end that the Fraser River sockeye fishery will be fully restored, maintained, protected, and will be extended wherever such possibility exists. Scientific research has isolated the cause of the pre-existing low level of abundance of Fraser River sockeye and the conditions for Japan's abstention from fishing of Fraser River sockeye are being fully complied with, as is shown by a review of the scientific research activities and related data of the Commission dealing with the management of the Fraser River sockeye.

The Fraser River sockeye population is made up of many discrete units, each having its own reproductive area and independent time of migration which is virtually the same time every year. The passage of each unit run in the fishery lasts for about 30 days, while the peak of each unit run usually lasts only about five days. These unit migrations, commonly called racial migrations, follow and closely overlap each other to the extent that sockeye are available in the fishery from late June to November of each year. Each racial migration is a separate management problem insofar as spawning requirements for maximum reproduction are concerned, although the offspring of several races may sometimes collect in the same freshwater rearing area, thereby creating an inter-relationship between races governed by the capacity of the cosmopolitan rearing area. For a reason not yet completely understood there is a naturally-established tendency for populations in each spawning and rearing area to reproduce every fourth year at a rate greater than that of the other three years combined. The consistency of this reproductive variation when the populations approach their maximum size has been traced back to 1823 from historical records and is commonly referred to as quadrennial dominance.

The effect of the Hell's Gate obstruction on the individual races varied according to their time of passage. Certain racial populations were destroyed, or nearly so, while others were decimated in varying degrees. The restoration of each population to its maximum sustainable level of abundance creates a

complex regulatory problem whenever there is overlapping in the time of migration of two or more races having distinctly separate levels of abundance.

The need for considering the management of each race as a separate problem, the overlapping migration time of the many races in the fishery, the variable productivity of each race on a quadrennial cycle—these and other factors create many management difficulties which can only be controlled by methods developed from careful scientific investigations.

The seasonal regulations are designed, on the basis of the anticipated size of the individual racial runs and the anticipated intensity of the fishery, to permit a uniform racial escapement of approximately 20 per cent—except in a few cases where a racial population is approaching its maximum level of abundance. It is now well established that under favorable reproductive conditions such an escapement will permit a rapid rate of population increase once a minimal number of spawners is available. Where a population is approaching its maximum limit, the desirable escapement level appears to be approximately 13 per cent in the year of the large quadrennial run, while in the three off-years a 20 per cent escapement tends to prevent an unnatural balance between the reproducers of the annual populations. The regulations are also designed to permit periodic escapement proportional to the daily abundance of each race as it passes through the fishery, although when practical the escapement is taken entirely from the peak of the run. This latter type of regulation is based on the philosophy, now almost factually established, that only the peak of the run is properly synchronized with the reproductive environment and that the fish from the beginning or end of each run are not normally capable of reproducing at a maximum rate because of their early or late migration.

The daily catch in both numbers and pounds by each type of gear and for each sub-fishing area is recorded for both the Canadian and United States fisheries, which extend over a combined estuarian and marine area approximately 200 miles in length. Extensive tagging operations conducted from 1938 to 1948, in which tagged fish were recovered on individual spawning grounds, have indicated the approximate time of passage of each race. Studies of the nuclear growth patterns of scales have yielded a method of identifying the racial origins of most of the fish at the time they are caught. Daily samples of scales, sex, weight and length permit computation of the daily racial fishing mortality by age, sex and size and race. Statistical examination of the catch below the fishing deadline immediately before and after each periodic closure is one means of measuring the periodic amount of the escapement. Test fishing during the closures is a means of verifying the amount of escapement. Scale, sex, weight and length samples taken from the commercial catch immediately before and after the closures and from the test fishing catches provide information on the racial composition of the periodic escapement.

During the fishing season current knowledge of the amount of racial catch in each major fishing area and the amount of racial escapement permits emergency regulatory adjustment of the fishery if the desired management policies are not being fulfilled. These policies require, among other things, that

the season's catch be equally divided between the two countries without under-fishing or overfishing any one race.

The passage of the escapement up the Fraser River is observed throughout the season at various native Indian fishing stations; these check observations are made to determine whether the upstream migration to the spawning grounds, in some cases more than 650 miles from the commercial fishing area, is proceeding normally. Natural obstructions in the tortuous channel of the river do occur at unusual water levels and these obstructions must be located, surveyed, and corrected to prevent delay in the upstream migration of adult fish en route to their spawning ground. Investigations at Hell's Gate revealed the disastrous effects of delay on the reproductive rate of the escaping spawners.

Time of arrival of sockeye on each spawning ground is recorded by means of periodic live counts which are used in conjunction with proven index factors to determine the relationship of arrival to normalcy in the environmental cycle. The total racial escapement is enumerated by tagging on the spawning grounds. Success of spawning is determined periodically throughout the spawning season by sampling adult females immediately after death. The fish arrive on the spawning grounds in the same chronological order as they escape from the commercial fishery and follow that order through spawning. Environmental factors extant during the ripening and spawning period are recorded for each spawning ground, and the complete annual environmental cycle is measured at key stations throughout the watershed. The effect of time and pattern of spawning on the survival rate can be determined, at least in part, by comparing the success of spawning between runs arriving under different conditions. Spawning ground sex ratios are determined during enumeration and the variations within and between populations are recorded. Experiments have been and are being conducted under field conditions to determine the effect of unbalanced sex ratios on the success of spawning.

Each spawning ground has been surveyed and mapped into gravel type, depth and velocity sections so that changes in density and distribution of spawners from year to year may be studied. Sockeye tend to select the most favorable spawning areas and only competition for space will force them to spawn in poor or totally unproductive areas. A study of spawning density and distribution combined with a knowledge of the total number of sockeye present has proven to be one of the best and most easily measured indicators of the attainment of an optimum spawning population when rearing limitation is not involved. Engineering studies are also carried on to measure depth of water, velocity of surface flow, size of gravel, depth of egg deposition and availability of dissolved oxygen, in order that the relationship between spawning density and fry production may be understood and assessed in physical terms.

The numerical relationships of spawners to eggs deposited, of eggs deposited to fry hatched, of fry hatched to seaward migrants, and of seaward migrants to surviving adults are being assessed each year by specially designed enumeration methods; these methods, including the use of photography, are being applied to one of the major spawning areas that is approaching its former maximum



FIGURE 1.—Scene of the 1955 block and delay point in the migration of the early July runs of sockeye en route to the spawning grounds. Delay in the spring runoff was the cause of the obstruction located near Yale, British Columbia, in the Fraser River Canyon. Physical corrective measures are planned for completion in 1956.

production. Similar supplementary work is being conducted in other areas in order to predict the population sizes in advance of the spawning migrations and to determine whether the natural size limitations of the populations occur in the spawning areas or in the related lake-rearing areas. When fry hatches exceed the capacity of the rearing area the surplus fry are of little value and represent adult fish which should have been taken by the commercial fishery.

A knowledge of the freshwater growth of each annual population can be obtained from measurements of the nuclear area of the scale. A relationship between numbers of fish and available food supply is established and in addition a measure of the spatial distribution of feeding fish in the large lake-rearing areas is made possible. The maximum production of seaward migrants does not occur unless the distribution of fish in a lake is uniformly related to the available food. The distribution of feeding fingerlings becomes particularly important when several spawning populations from separate tributary streams are reared in the same lake; to obtain maximum production the escapement of each tributary population must be controlled as much as is practical so that there is uniform distribution of the young fish in relation to the food supply.

Scale, length, and sex samples are taken to permit final computation of the total racial population by brood years. Fraser River sockeye are predominantly four years old at maturity but varying numbers of three and five-year-old fish occur, which makes it desirable to enumerate both the catch and the escapement by age-class so that the production from each spawning population may be determined. It is also necessary to collect scales from three-year-old fish, if scales have not been collected previously from the seaward migrants, in order that the four-year-old fish in the following year's catch can be assigned to their appropriate reproductive area. Certain populations, mostly from the Fraser River watershed below Hell's Gate, annually exhibit a varying but complex age composition. Study of these mixed age populations is being made to determine the inter-relationship of age composition and the size of the escapement and its possible effect on the productivity of the annual and cyclical racial populations and to establish whether age composition may be an index of a possible relationship between age composition and annual productivity.

Annual predator abundance, possible cyclical occurrence of parasites or competitors, and effect of each annual population of sockeye on the freshwater food supply are being continuously studied in an effort to find the cause or causes of the quadrennial cycle in productivity. Regardless of whether it is controllable, knowledge of the cause of this natural quadrennial cycle makes it possible to properly relate the size of the escapement to this controlling variable in annual productivity.

The foregoing studies and investigations are necessary management functions if maximum production from a minimum escapement is to be obtained and production is to be maintained on the highest possible level. Extreme diligence must be exercised in the regulation of the fishery to guarantee that in harvesting the catch the productivity of each racial population is not impaired. The fishing gear may be selective in its effect on the age, size, sex, and timing of

the racial escapement. Studies to date reveal that size and sex selectivity does occur in the Fraser River sockeye fishery but there is no proven evidence that the amount of this type of selectivity existing in the fishery since its inception has had any adverse effect on productivity. In certain cases the occurrence of age selectivity may possibly interfere with maximum production but studies on the effect of age selectivity in the fishery are not yet completed. Selective timing of the escapement produces maximum productivity when the escapement is obtained from the peak of the run rather than from the beginning or end of the run. Early fish tend to die without spawning and late fish appear to be unproductive because of the effect of low water temperatures on fertilization and incubation of the spawn.

The obtaining of racial escapements of predetermined size from sockeye populations which overlap in the timing of their availability to the fishery is a very complex regulatory problem which is further complicated by the necessity of equally dividing the allowable season's catch between the fishermen of Canada and the United States. Changes in the efficiency of fishing gear, development of new fishing areas, and rapid changes in the size of the fishing fleet strongly affect the probability of providing racial escapements capable of producing maximum returning runs. The existing fishery is already capable of taking almost the entire run of Fraser River sockeye in any half of the existing fishing area. The existence of this intense and effective fishery over this extended fishing area necessitates long periodic closed seasons to obtain proper racial escapements. The quantity and composition of the escapement becomes more difficult to control as the intensity and effectiveness of the fishery increases and longer closed seasons are provided to permit escapement. If a peak of a racial run, lasting only five days, is, by chance, available to an intensive fishery the escapement becomes too small and tends to be composed of relatively unproductive fish from the beginning and end of the run. If the peak of a run is by chance not available to such a fishery because of a long closed season, the escapement tends to be excessive. A fishing fleet which is fairly stable in size, efficiency and area of operation is essential to the proper management of a fishery directed to producing a maximum sustainable catch from a minimum escapement.

Knowledge obtained from the previously detailed studies and investigations is essential to directing the restoration of sockeye populations where the original populations were exterminated by the Hell's Gate obstruction or to directing the extension of sockeye production to areas not previously productive because of natural limitations. In transferring populations from one spawning and rearing area to another knowledge of the genetic relationship of the population to its migratory and reproductive environment is indispensable. Experiments in transplanting Fraser River sockeye populations indicate that the distance of the spawning area from the sea, where feeding of the adult ceases, must be approximately the same for both the donor and receiver area. The environmental cycle affecting the reproductive area must likewise be the same in the receiver area as the environmental cycle affecting reproduction in the donor area. The proven inability of sockeye to adjust themselves to new

and different reproductive environments makes these considerations necessary if transplants are to be successful and the resulting populations capable of a rate of natural reproduction which will allow normal cropping by the commercial fishery.

Two methods of transplantation have been tried in adherence to the above-mentioned principles. Ten experiments using fingerlings have failed where the transplant was from one tributary watershed to another. Two experiments using eyed-eggs subsequently incubated in the gravel of the receiver stream have both been eminently successful in providing returning adult spawners with migrations properly timed to meet the known environmental requirements for successful spawning and incubation. The same principles coupled with knowledge of the factors controlling successful reproduction are being used in an attempt to design artificial spawning grounds adjacent to lake rearing areas where no natural spawning grounds exist or where the natural spawning grounds are limited. This action could extend the reproductive range of the Fraser River sockeye populations.

Knowledge obtained from the previously detailed studies and investigations is essential to protecting the Fraser River sockeye populations from the adverse effects of industrial development within the watershed. Incomplete knowledge of the environmental requirements of sockeye during migration and spawning and the lack of remedial measures resulted in the tremendous loss in production due to railroad construction at Hell's Gate. The obtaining of the required knowledge not only resulted in the necessary correction of the problem at Hell's Gate but formed the basis for determining the tolerance of the species to the effect of dams, water diversions, pollution, watershed logging, and other industrial operations. This newly-obtained information has made it possible to protect the watershed for the maximum reproduction of sockeye. Industrial projects have either been designed to avoid interference with the reproduction of sockeye or they have been located in areas where there is no adverse effect. Studies and investigations are being continued to develop or improve artificial aids to salmon management such as fishways, fish diverters, artificial spawning grounds, and hatchery techniques.

The results obtained from the scientific management of the Fraser River sockeye fishery and the research activity of the International Pacific Salmon Fisheries Commission which are recorded in the annual reports or the research bulletins of the Commission indicate that:

1. A more intensive exploitation of the present stocks will lower rather than increase the sustainable yield.
2. The fishery is so regulated that the Fraser River sockeye stocks are increasing in size with a few stocks approaching their maximum sustainable size; such regulation being in accordance with the known biological requirements for producing a maximum sustainable catch from a minimum escapement.
3. The Fraser River sockeye stocks are being fully utilized or are being protected on the basis of scientific evidence so that they will be capable

of full utilization as they approach their maximum size; such population limits being determined and obtained from scientific study of the natural factors controlling those limits.

4. The conditions necessary for obtaining and maintaining maximum productivity have been or are being determined.

COMMISSION MEETINGS

The *first* meeting of the International Pacific Salmon Fisheries Commission during the year 1955 was held on January 8 in Vancouver, B.C. At this time the proposed recommendations for regulation for 1955 were reviewed with the Advisory Board and the fact emphasized that some of the usable indices for regulation of the fishery were rapidly becoming obsolete because of the tremendous increase in the amount and efficiency of the fishing gear and because of the continuous expansion of fishing areas. Advisory Board members present for Canada were: Mr. R. Nelson, salmon canners; Mr. W. Pitre, purse-seine fishermen; Mr. P. Jenewein, gill-net fishermen; Mr. M. W. Black, sport fishermen. For the United States: Mr. J. N. Plancich, salmon canners; Mr. N. Mladinich, purse-seine fishermen; Mr. C. Karlson, gill-net fishermen; Mr. J. Brown, troll fishermen; Mr. H. Gray, sport fishermen. Representations from all Board members were heard during the morning session. At a later session the Commission reviewed the recommendations, discussed the representations of the Board and then approved the final recommendations for submission to the respective governments. Consideration was also given to the various proposed hydroelectric developments which would affect the Fraser River watershed and to further study of the problem of guiding downstream migrant sockeye at Baker River. This study was being carried on in cooperation with the Departments of Fisheries of Canada and of the State of Washington with assistance from the Puget Sound Power and Light Company.

The *second* Commission meeting of 1955 was held on May 31 and June 1 in Washington, D.C., where the Commission met with representatives of the Department of State, Bureau of the Budget and U.S. Fish and Wildlife Service. Detailed reports on the current accomplishments of the Commission and the major proposed programs for fulfilling the treaty obligations to restore the Fraser River sockeye run were presented.

The *third* Commission meeting of the year was held in Ottawa, Ontario, on June 2 and 3. At this meeting with General A. G. L. McNaughton, Chairman, Canadian Section, International Joint Commission, the Honourable James Sinclair, M.P., Minister of Fisheries, the Deputy Minister of Fisheries, the Assistant Deputy Minister of Fisheries, the Chairman of the Fisheries Research Board of Canada and members of the Canadian Department of Fisheries were in attendance. The Chairman of the Commission outlined the basic fishery problems which would arise if hydroelectric power were developed on the Fraser and Thompson Rivers. General McNaughton then spoke extemporaneously on the various considerations involved in power development in British Columbia and in the Columbia River Basin in the United States and Canada. The Minister of Fisheries informed the Commission of impending plans for

hydroelectric development on the Fraser River and stated that his Department would resist such developments until every other source of power had been used. He further stated that the Department of Fisheries would depend on the International Pacific Salmon Fisheries Commission for continued help and advice in connection with the problems of protecting the sockeye salmon resource of the Fraser River.

The *fourth* Commission meeting was held on July 28 in the Commission offices in New Westminster, B.C. The Director of Investigations reviewed the catches and escapements for the 1955 season up to that date, stating that the early runs appeared to be about forty per cent below that of the brood year and re-emphasized the difficulties involved in obtaining equal division of the catch and proper escapement from the Adams River sockeye run because of its intermingling with the large pink salmon run. He then explained the drastic changes in the current fishery compared with the brood year, every change being directed towards taking a higher percentage of the available sockeye and consequently causing a critical reduction in the spawning escapement. In an effort to fulfill the treaty obligations the Commission implemented special regulatory measures (as set forth below under 1955 Regulations) for both the United States and Canada.

The *fifth* Commission meeting in 1955 was on October 24 in Seattle, Washington. The Director gave a comprehensive review of the sockeye fishery in Canadian and United States waters and the escapement to the various spawning areas of the Fraser River watershed, with special emphasis on the radical changes—in fishing intensity, gear efficiency and the extent of fishing area—and their effect on the proper scientific management of the resource. The disadvantages of an expanding high-seas fishery, especially as regards fishery stability and management were thoroughly discussed and a statement outlining these disadvantages was forwarded to the Canadian and United States governments. The recent report of the International Law Commission was reviewed, special attention being given to the section dealing with exploitation of the living resources of the sea. The two federal governments were notified of the failure of the International Law Commission to recognize either the principle of abstention or the need for considering anadromous fish as a special case, and were advised of the relationship of the situation to the Commission's terms of reference.

The subject of the proposed power development on the Fraser River system was reviewed fully in a report from Mr. M. C. Bell, Engineering Consultant, on the cost and effectiveness of fish protection devices, in which he pointed out that costly fishways would reduce the water potential for power generation and thus increase the cost of power. Mr. Bell emphasized that cumulative delay of adults below the four proposed dams on the lower Fraser River and the six proposed dams on the main Thompson River combined with an 80 per cent loss in seaward migrants would result in the total destruction of the affected sockeye resource regardless of any fish-saving device that might be constructed.

The *sixth* and final meeting of 1955 was held on December 8 and 9 in Vancouver, B.C., at which time Mr. Herbert North was appointed as the Advisory Committee representative of the Canadian Trollers, replacing Mr. Morgan Berg who had tendered his resignation. The Commission and staff met with all members of the Advisory Committee and representatives of the industry and press. The staff discussed: (1) industrial development of the Fraser River system; and (2) research on downstream migrants. These two topics were then taken up by the Chairman of the Commission who emphasized that in spite of the efforts of the Department of Fisheries and the Commission no device or system had been found, as far as we know, that would bring migrant salmon safely over a dam or through the turbines. He stressed that continued concerted efforts must be made by all those interested in the welfare of the Fraser River salmon to insure the security of the resource. Further staff discussions dealt with: (3) restocking experiments and the development of artificial spawning grounds; (4) potential sockeye runs for each cyclical year; (5) catch, escapement and changes in the fishery during the 1955 season; and (6) racial fishing mortalities for each fishing area in 1955. Subsequently, the Chairman defined the existing problems of management and regulation brought about by recent changes in the fishery, namely the increases in intensity and gear efficiency and the expansion of fishing areas. The Director then discussed the general expectations for racial runs and catches in 1956 and reviewed at length the serious management problems involved in designing the proposed 1956 regulations. The staff recommendations for regulatory control of sockeye fishing in Convention waters in 1956 were then presented for further study by the Advisory Committee.

1955 REGULATIONS

Recommendations for regulations governing the management of the sockeye fishery were considered and adopted at a meeting of the Commission held with its Advisory Committee in Vancouver, B.C., on January 8, 1955.

The recommendations for regulations, as approved by the Commission, were transmitted to the Departments of Fisheries of Canada and of the State of Washington and to the Secretary of the Interior at Washington, D.C. The recommendations were accepted in substance for Canadian waters by an Order-in-Council adopted on June 2, 1955 and for the United States waters by an Order of the Director of the Washington State Department of Fisheries promulgated April 1, 1955.

Canadian Convention Waters

The recommendations of the Commission for Canadian Convention waters were as follows:

"The International Pacific Salmon Fisheries Commission appointed pursuant to the Convention between Canada and the United States of America for the protection, preservation, and extension of the Sockeye Salmon Fisheries in the Fraser River System, signed at Washington on the 26th day of May, 1930, hereby recommends that regulations to the following effect, in the interests of

such fisheries, be adopted by Order-in-Council as amendments to the Special Fishery Regulations for British Columbia, for the season of 1955, under the authority of the Fisheries Act, namely:

1. That in the waters of District No. 1 and in those waters of the southern portion of District No. 3 bounded on the west by the Forty-ninth Parallel, projected from the Vancouver Island shore in the vicinity of Florencia Bay (excepting all the waters of Barclay Sound eastward of an imaginary straight line drawn from Amphitrite Point to Cape Beale, and all the waters of Nitinat Lake and entrance thereto) and bounded on the north by an imaginary straight line drawn from Welcome Point to Sechelt Peninsula, thence along an imaginary straight line drawn to Point Young on Lasqueti Island, thence in an imaginary straight line drawn to Dorcas Point on Vancouver Island, it shall be unlawful for anyone to buy, sell, or have in his possession any sockeye salmon taken in those waters during the times when fishing for or taking sockeye salmon is prohibited therein.

2. That in the waters of the said southern portion of District No. 3 embraced in Areas 19, 20, 21 and 23, but not including the waters of Barclay Sound eastward of an imaginary straight line drawn from Amphitrite Point to Cape Beale, no one shall fish for sockeye salmon by means of purse seines from one minute after twelve o'clock in the forenoon of Friday of each week to one minute after twelve o'clock in the forenoon of the Monday following commencing on June thirtieth, 1955 and continuing to and including August first, 1955; nor shall anyone fish during the period of the fishing season specified herein for sockeye salmon by means of gill nets or traps from six o'clock in the afternoon of Thursday of each week to six o'clock in the afternoon of the Sunday following.

3. That in the waters of the said southern portion of District No. 3 embraced in Areas 19, 20, 21 and 23, but not including the waters of Barclay Sound eastward of an imaginary straight line drawn from Amphitrite Point to Cape Beale, no one shall fish for sockeye salmon by means of purse seines from one minute after twelve o'clock in the forenoon of Saturday of each week to one minute after twelve o'clock in the forenoon of the Monday following commencing on August first, 1955 and continuing to and including August twenty-second, 1955; nor shall anyone fish during the period of the fishing season specified herein for sockeye salmon by means of gill nets or traps from six o'clock in the afternoon of Friday of each week to six o'clock in the afternoon of the Sunday following.

4. That in the waters of the said southern portion of District No. 3 embraced in Areas 17 and 18 no one shall fish for sockeye salmon by means of purse seines from one minute after twelve o'clock in the forenoon of Friday of each week to six o'clock in the forenoon of the Monday following commencing on June thirtieth, 1955 and continuing to and including August eighth, 1955; nor shall anyone fish during the period of the fishing season specified herein for sockeye salmon by means of gill nets from eight o'clock in the forenoon of Friday of each week to two o'clock in the afternoon of the Monday following.

5. That in the waters of the said southern portion of District No. 3 embraced in Areas 17 and 18 no one shall fish for sockeye salmon by means of purse seines from one minute after twelve o'clock in the forenoon of Friday of each week to one minute after twelve o'clock in the forenoon of the Tuesday following commencing on August eighth, 1955 and continuing to and including August thirtieth, 1955; nor shall anyone fish during the period of the fishing season specified herein for sockeye salmon by means of

gill nets from eight o'clock in the forenoon of Friday of each week to eight o'clock in the forenoon of the Tuesday following.

6. That in the waters of the said southern portion of District No. 3 embraced in Areas 17 and 18 no one shall fish for sockeye salmon by means of purse seines from one minute after twelve o'clock in the forenoon of Friday of each week to one minute after twelve o'clock in the forenoon of the Monday following commencing on August thirtieth, 1955 and extending to September fifteenth, 1955; nor shall anyone fish during the period of the fishing season specified herein for sockeye salmon by means of gill nets from eight o'clock in the forenoon of Friday of each week to eight o'clock in the forenoon of the Monday following.

7. That in the waters of the said southern portion of District No. 3 embraced in Areas 17 and 18 no one shall fish for sockeye salmon by means of purse seines from one minute after twelve o'clock in the forenoon of Thursday, September fifteenth, 1955 to one minute after twelve o'clock in the forenoon of Tuesday, September twentieth, 1955; nor shall anyone fish during the period of the fishing season specified herein for sockeye salmon by means of gill nets from eight o'clock in the forenoon of Thursday, September fifteenth, 1955 to eight o'clock in the forenoon of Tuesday, September twentieth, 1955.

8. That in the waters of District No. 1 other than those above Pattullo Bridge at New Westminster, no one shall fish for sockeye salmon from eight o'clock in the forenoon of Friday of each week to two o'clock in the afternoon of the Monday following commencing on June thirtieth, 1955 and continuing to and including August eighth, 1955; nor shall anyone fish during the period of the fishing season specified herein for sockeye salmon in those waters where commercial fishing is permitted above the Pattullo Bridge at New Westminster by means of gill nets from eight o'clock in the forenoon of Friday of each week to six o'clock in the afternoon of the Monday following.

9. That in the waters of District No. 1 other than those above Pattullo Bridge at New Westminster, no one shall fish for sockeye salmon from eight o'clock in the forenoon of Friday of each week until eight o'clock in the forenoon of the Tuesday following commencing on August eighth, 1955 and continuing to and including August thirtieth, 1955; nor shall anyone fish during the period of the fishing season specified herein for sockeye salmon in those waters where commercial fishing is permitted above the Pattullo Bridge at New Westminster by means of gill nets from eight o'clock in the forenoon of Friday of each week until twelve o'clock in the forenoon of the Tuesday following.

10. That in the waters of District No. 1 other than those above Pattullo Bridge at New Westminster, no one shall fish for sockeye salmon from eight o'clock in the forenoon of Friday of each week until eight o'clock in the forenoon of the Monday following commencing on August thirtieth, 1955 and continuing to and including September fifteenth, 1955; nor shall anyone fish during the period of the fishing season specified herein for sockeye salmon in those waters where commercial fishing is permitted above the Pattullo Bridge at New Westminster by means of gill nets from eight o'clock in the forenoon of Friday of each week until twelve o'clock in the forenoon of the Monday following.

11. That in the waters of District No. 1 other than those above Pattullo Bridge at New Westminster, no one shall fish for sockeye salmon from eight o'clock in the forenoon of Thursday, September fifteenth, 1955 to eight o'clock in the forenoon of Tuesday, September twentieth, 1955;

nor shall anyone fish during the period of the fishing season specified herein for sockeye salmon in those waters where commercial fishing is permitted above the Pattullo Bridge at New Westminster by means of gill nets from eight o'clock in the forenoon of Thursday, September fifteenth to twelve o'clock in the forenoon of Tuesday, September twentieth, 1955.

12. The Chief Supervisor of Fisheries for British Columbia, consistent with authority vested in him, may implement recommendations which may be made by the International Pacific Salmon Fisheries Commission respecting any change in close times for fishing for sockeye salmon in waters of District No. 1 and in those waters of the southern portion of District No. 3 described in section one hereof by posting a notice of any change in close time so recommended on the cannery or canneries adjacent to the area or areas thereby to be affected at least twenty-four hours before the commencement of such change in close time.

13. Nothing contained herein shall apply to the taking of sockeye salmon in the waters of District No. 1 and in those waters of the southern portion of District No. 3 described in section one hereof by the International Pacific Salmon Fisheries Commission or its duly authorized representatives.

14. These regulations shall be effective on and after June thirtieth, 1955 and shall remain in force until September twenty-fifth, 1955."

On the recommendation of the International Pacific Salmon Fisheries Commission modifications were later made in the 1955 regulations governing sockeye fishing in Canadian Convention waters that had been approved by the Order-in-Council referred to above.

Because of a marked decline in the size of the runs as compared with the brood year and the phenomenal increase in fleet size and efficiency, an increase in the weekly close time was necessitated both in the interests of conservation and equal division of the catch. In Canadian Convention waters included in Areas 19, 20, 21 and 23 the weekly close time was increased by forty-eight hours during the period August 3 to August 10, the closure being from 6:00 p.m. August 4 and continuing to 6:00 p.m. August 8 for gill nets and traps and from 12:01 a.m. August 5 to 12:01 a.m. August 9 for purse seines. In Areas 17 and 18 the weekly close time was increased by 18 hours during the period July 27 to August 10, the closures being from 8:00 a.m. Friday, to 8:00 a.m. Tuesday, for gill nets and from 12:01 a.m. Friday to 12:01 a.m. Tuesday for purse seines.

In District No. 1 below Pattullo Bridge the weekly close time was increased to 96 hours for the period July 27 to August 10 becoming 8:00 a.m. Friday, to 8:00 a.m. Tuesday. Above Pattullo Bridge the weekly close time ceased 4 hours later than in that part below Pattullo Bridge.

An addition of twenty-four hours to the normal weekly close time for District No. 1 and Areas 17 and 18 commencing on Friday, September 9 was instituted by the Chief Supervisor of Fisheries thereby extending the weekly closure through September 12 because of the negligible spawning escapement of pink salmon up to that time.

Upon termination of the closure of District No. 1 and Areas 17 and 18

TABLE I
SOCKEYE CATCH BY GEAR

United States Treaty Waters											
Purse Seines				Gill Nets				Reef Nets			
Year	Units	Catch	Percentage	Units	Catch	Percentage	Units	Catch	Percentage	Units	Total Catch
1943.....	139	202,927	83.93	22	5,688	2.35	57	33,161	13.72		241,776
1947.....	174	76,691	86.93	29	1,770	2.01	60	9,758	11.06		88,219
1951.....	242	875,607	77.02	177	152,372	13.40	105	108,497	9.54		1,136,791*
1955.....	286	621,527	61.74	584	282,995	28.11	88	102,088	10.15		1,006,610

Canadian Treaty Waters											
Purse Seines				Gill Nets				Traps			
Year	Units	Catch	Percentage	Units	Catch	Percentage	Units	Catch	Percentage	Units	Total Catch
1943.....	—	—	—	854	330,988	94.84	4	18,023	5.16		349,011
1947.....	97	44,011	12.40	1,072	307,407	86.58	5	3,617	1.02		355,035
1951.....	50	214,187	16.63	1,148	1,031,963	80.11	5	42,012	3.26		1,288,162
1955.....	104	462,934	41.78	1,348	625,207	56.42	5	18,548	1.67		1,108,081**

* Includes 315 Drag Seine caught sockeye.
** Includes 1,392 Troll caught sockeye.

NOTE: Gear counts represent the maximum number of units delivering on any single day.

TABLE II
CYCLIC LANDINGS AND PACKS OF SOCKEYE

	<i>United States</i>	<i>Canada</i>	<i>Total</i>
* 1955			
Total Landings (No. Sockeye).....	1,006,610	1,108,081	2,114,691
Share in fish.....	47.60%	52.40%	
Total Pack (48 lb. Cases).....	85,136	95,377	180,513
Share in pack.....	47.16%	52.84%	
1952-1955			
Total Landings (No. Sockeye).....	8,958,780	8,977,269	17,936,049
Share in fish.....	49.95%	50.05%	*
Total Pack (48 lb. Cases).....	879,593	874,093	1,753,686
Share in pack.....	50.16%	49.84%	
1948-1951			
Total Landings (No. Sockeye).....	4,503,574	3,956,121	8,459,695
Share in fish.....	53.24%	46.76%	
Total Pack (48 lb. Cases).....	405,597	358,189	763,786
Share in pack.....	53.10%	46.90%	
1955 Cycle Pack			
1955.....	85,136	95,377	180,513
1951.....	118,151	134,400	252,551
1947.....	6,760	29,170	35,930
1943.....	19,060	30,280	49,340
1939.....	43,511	54,296	97,807
**1935.....	54,677	62,822	117,499
1931.....	87,211	40,947	128,158
1927.....	97,594	61,393	158,987
1923.....	47,402	31,655	79,057
1919.....	64,346	38,854	103,200
1915.....	64,584	91,130	155,714
1911.....	127,761	58,487	186,248
1907.....	96,974	59,815	156,789
1903.....	167,211	204,809	372,020

* 19 Canneries in the United States and 11 canneries in Canada received the sockeye caught in Convention waters.

** 1903 to 1935 from Pacific Fisherman, 1948 Yearbook Number, p. 139.

from September 15 to September 20 for the protection of sockeye runs the Chief Supervisor of Fisheries found that a continued closure was required to protect the pink salmon run. This closure remained in effect until 8:00 a.m. October 11 except that on September 22 and September 29 fishing with linen gill nets of not less than 9 inches extension measure or nylon gill nets of not less than 9¾ inches extension measure were permitted and also that salmon net fishing as defined by the British Columbia Fishery Regulations was permitted from 8:00 a.m. October 3 in Areas 17 and 18 and in District No. 1 outside a line commencing at Boundary Bluff on Point Roberts thence in a straight line to the most westerly point of the international boundary line in the Gulf of Georgia, thence in a straight line to the most northerly point of Valdez Island, thence in a straight line to Thrasher Rock Light, thence in a straight line through the most westerly end of the North Arm jetty to the mainland on Point Grey. The additional closures for protection of the pink salmon runs also proved instrumental in the prevention of overfishing on the late run sockeye destined for the streams of the lower Fraser River.

The statutory weekly close times of the Department of Fisheries were in effect in District No. 1 from October 11 until the closure to salmon net fishing at 8:00 a.m. November 11 with the exception of one special closure from 8:00 a.m. October 27 until 8:00 a.m. November 7. The seasonal closure of the commercial fishing area above Pattullo Bridge became effective at 8:00 a.m. September 30.

United States Convention Waters

The recommendations of the Commission for United States Convention waters were as follows:

"The International Pacific Salmon Fisheries Commission appointed pursuant to the Convention between Canada and the United States of America for the protection, preservation, and extension of the Sockeye Salmon Fisheries in the Fraser River System, signed at Washington on the 26th day of May, 1930, hereby recommends to the Director of Fisheries of the State of Washington that regulations to the following effect, in the interests of such fisheries, be adopted by him by virtue of authority in him vested by Section 6 of Chapter 112 of the Laws of the State of Washington of 1949, namely:

1. That in the waters of the United States of America embraced in Article I of the Convention between Canada and the United States of America for the protection, preservation, and extension of the Sockeye Salmon Fisheries in the Fraser River System, signed at Washington on the 26th day of May, 1930, it shall be unlawful for anyone to buy, sell, or have in his possession sockeye salmon taken during the times when fishing for or taking sockeye salmon is prohibited therein.

2. That in the waters of the United States embraced in Article I of the said Convention no one shall fish for sockeye salmon by means of purse seines or reef nets from one minute after twelve o'clock in the forenoon of Friday of each week to one minute after twelve o'clock in the forenoon of the Monday following commencing on June thirtieth, 1955 and continuing to and including August first, 1955; nor shall anyone fish during the period of the fishing season specified herein for sockeye salmon by means

of gill nets from six o'clock in the afternoon of Thursday of each week to six o'clock in the afternoon of the Sunday following.

3. That in the waters of the United States embraced in Article I of the said Convention no one shall fish for sockeye salmon by means of purse seines or reef nets from one minute after twelve o'clock in the forenoon of Saturday of each week to one minute after twelve o'clock in the forenoon of the Monday following commencing on August first, 1955 and continuing to and including August eighth, 1955; nor shall anyone fish during the period of the fishing season specified herein for sockeye salmon by means of gill nets from six o'clock in the afternoon of Friday of each week to six o'clock in the afternoon of the Sunday following.

4. That in the waters of the United States embraced in Article I of the said Convention no one shall fish for sockeye salmon by means of purse seines or reef nets from four o'clock in the afternoon of Friday of each week to four o'clock in the forenoon of the Sunday following commencing on August eighth, 1955 and continuing to and including August twenty-ninth, 1955; nor shall anyone fish during the period of the fishing season specified herein for sockeye salmon by means of gill nets from six o'clock in the forenoon of Saturday of each week to six o'clock in the afternoon of the Sunday following.

5. Nothing contained in any rules or regulations relating to fishing for or taking sockeye salmon shall apply to the taking of sockeye salmon within the waters of the United States of America embraced in Article I of the said Convention by the International Pacific Salmon Fisheries Commission or its servants or agents acting pursuant to its directions for the purpose of exercising its objects under the said Convention.

6. The Commission further recommends that the Director of Fisheries for the State of Washington consistent with authority in him vested implement recommendations which may be made by the International Pacific Salmon Fisheries Commission, through its Chairman, respecting any change in close times for fishing for sockeye salmon in those waters of the United States of America embraced in Article I of the said Convention."

In order to facilitate adequate escapement and equal division of the season's catch the approved regulations as detailed above were later altered on the recommendation of the International Pacific Salmon Fisheries Commission for the first two weekends in August. An additional twenty-four hours was added to the originally approved closed period for the first weekend in August making the weekend closure for gill nets from 6:00 p.m. August 3 to 6:00 p.m. August 6 and for purse seines and reef nets from 12:01 a.m. August 4 to 12:01 a.m. August 7. The weekly closed period for August 10 to August 17 was extended by twelve hours making the weekly closed period for gill nets from 6:00 p.m. August 11 to 6:00 p.m. August 13 and for purse seines and reef nets from 12:01 a.m. August 12 to 12:01 a.m. August 14.

As a conservation measure for pink salmon the Director of the Washington Department of Fisheries on August 16 increased the originally approved 36-hour weekly closed period by 12 hours in the Convention waters of Puget Sound following the same schedule as established for the previous weekend. This order remained in effect until the end of the salmon net fishing season. As a further measure to conserve the pink salmon run all waters west of a line

projected from Point Roberts Light to Patos Island Light were closed to commercial fishing at 12:01 a.m. September 15 and remained closed for the balance of the fishing season. Both of the extra closures for the protection of the pink salmon runs provided some of the required protection for late-running sockeye but not sufficient protection to prevent overfishing on the Adams River run which was particularly vulnerable to the concentration of Canadian and United States gear operating simultaneously on the larger pink salmon populations.

High Seas

The regulations for the high seas were as follows:

"Under the authority of the Convention hereinafter mentioned, the International Pacific Salmon Fisheries Commission at its meeting in Vancouver, British Columbia on the eighth day of January, 1955, made and adopted the following order and regulation, namely:

'taking sockeye salmon on the high seas described in paragraph numbered 1 of Article I of the Convention between the United States of America and the Dominion of Canada for the protection, preservation, and extension of the Sockeye Salmon Fisheries in the Fraser River System, signed at Washington on the 26th day of May, 1930, is hereby prohibited from midnight Thursday to midnight the following Sunday during each weekly period between June 30th and August 1st, both dates inclusive, for the year 1955, and further that in the same waters the taking of sockeye salmon is hereby prohibited from midnight Friday to midnight the following Sunday during each weekly period between August 1st and August 15th, both dates inclusive, for the year 1955; provided that this Order and Regulation shall apply only to nationals and inhabitants and vessels and boats of the United States of America and the Dominion of Canada: this Order and Regulation being affirmatively voted by three Commissioners of each 'High Contracting Party.'"

Patrol agencies of both the United States and Canada provided adequate equipment and officers for the enforcement of the High Seas regulation protecting the Fraser River sockeye. No violations were reported.

THE UNITED STATES FISHERY

The United States fishery increased its catch of the total run from 36.43 per cent in the brood year (1951) to 38.80 per cent in 1955. This increased catch occurred in spite of a seventy-two-hour weekly closed season from July 1 to August 10 compared with a forty-eight-hour closed season operative over the same period in the brood year. The increase in the percentage caught by the United States combined with a 17 per cent decline in the numerical strength of the season's population over that of the brood year resulted in some overfishing by the United States fishing fleet.

The total purse-seine unit landings for the season actually declined slightly in 1955 from the total purse-seine unit landings recorded in 1951, the brood year, in spite of an increase in the maximum number of boats landing in any one day (Table I). The small decline in purse-seine fishing effort was offset,

however, by the increased efficiency resulting from the installation of the Puretic Power Block on almost all the boats before the fishing season ended.

The increase in the number of gill nets from 177 in the brood year 1951 to 584 in 1955 made it difficult to obtain adequate escapement through United States waters. The increase in gill net fishing-intensity together with the increase in unit gill net efficiency occasioned by the general introduction of nylon nets for the first time on this cycle greatly reduced the value of the statistical methods developed in past years for measuring the percentage of each of the several runs being caught in United States waters. An important consequence of the heavy gill net fishing-pressure was that an effective United States gill net fishery was initiated on the high seas in an effort to avoid competition and to get the first catch from the incoming runs.

The expanding fishery and improved gear in territorial waters is becoming extremely difficult to control but the establishment by the United States of an effective high-seas fishing fleet operating in competition with an effective inside fishing fleet will make sound racial management almost impossible. Since the Commission has no power to control gear it is obligated to control fishing areas in order to reduce fishing efficiency to a reasonable level. It is estimated that the United States fishing efficiency reached 90 per cent on certain fishing days during the peak of the season.

A detailed record of the cycle-year catches of sockeye in United States Convention waters is presented in Table III.

THE CANADIAN FISHERY

The trend, of increasing fleet size, increasing gear efficiency, and expanding fishing areas established in the Canadian fishery during the past few years, continued steadily in 1955. The increase in the number of gill nets and purse seines fishing the Sooke-San Juan area was phenomenal. The average daily number of seines increased by 187.6 per cent in July and by 151.0 per cent in August over the number operating during the same periods in 1951. In addition to the numerical increase in the purse-seine fleet from 50 units in 1951 to 104 units in 1955, the general efficiency of the gear was increased at least 15 per cent by the utilization of the Puretic Power Block.

The newly-established gill net fishery in the Sooke-San Juan area which increased in size from 11 boats in 1951 to 269 boats in 1955 proved to be unusually effective. The average daily unit catch of the gill nets was 25.3 per cent of the average daily unit catch of the purse seines. Almost the entire allowable Canadian share of the catch from the Adams River run of sockeye was taken in the Sooke-San Juan area and the catch from this run by gill nets at the mouth of the Fraser River was of necessity entirely at the expense of the required escapement.

Since the Commission has no control over increases in the number or efficiency of the gear it must resort to restricting fishing areas if sound management is to be obtained under the existing circumstances. It is becoming

SALMON COMMISSION

TABLE III
DAILY CATCH OF SOCKEYE, 1943-1947-1951-1955 FROM UNITED STATES TREATY WATERS

Date	JULY				AUGUST				SEPTEMBER			
	1943	1947	1951	1955	1943	1947	1951	1955	1943	1947	1951	1955
1	2				5,690	9	57,324	54,283	1,838	2,952		3,091
2			13,102		8,912	10	42,143	76,174	2,084	1,587	933	393
3			6,615		14,001	4	27,199	46,271	1,270	1,181	544	4
4			9,589	7,228	14,738	6		1,453		1,482	990	2,051
5			9,057	12,418	7,784	47	0	1,406	1,057	984	502	1,920
6			9,490	6,713	6,895	147	45,986		931		334	1,463
7	23			3,475	9,058	826	27,966	48,429	905	714	138	894
8	3				3,746	46	33,746	82,783	1,302	622		301
9	1		23,677		4,282	352	20,411	55,147	1,022	406	266	42
10	25		10,244		5,582	1,100	56	42,281	1,168		1,254	0
11	16		8,156	7,863	10,623	526	0	28,216		316	33,599	291
12	66		6,570	8,435	10,375	559	0	1,806	210	248	6,580	274
13	178		5,418	7,619	5,342	5			357	290		47
14	417			7,265	6	37	40,432	30,632	346	805	138	128
15	455				8,479	45	40,912	38,577	225	106		53
16	1,370		16,435		4,918	710	39,620	37,916	141	105	149	11
17	451		16,563		4,948		23,050	46,499	45	443	234	
18	2,115		12,476	17,079	5,912	4,379	310	29,174		125	109	137
19	1,931		13,506	17,791	4,554	8,743	396	5,763	18	240	109	77
20	4,345		14,314	14,314	1,271	8,431	10,041	3,014	13		285	
21	2,335	6		13,553	60	7,839	10,788	20,338	27	69	216	115
22	1,847	21			6,037	3,944	8,337	15,236	45	87		79
23	1,754	9	58,796		8,049	79	5,758	20,773	20	272	38	9
24	2,387		59,917		6,250	8,119	2,214	16,376	8	57	9	
25	5,592		54,748	42,932	7,424	4,953	83	12,216		36	14	32
26	5,266	8	45,817	15,254	5,017	5,894	4	3,705	3	42	7	6
27	3,248	14	42,981	30,881	2,280	6,234		789	8		1	13
28	4,048			31,220		5,536	2,471	9,584		13	2	54
29	5,899				3,849	3,097	7,489	5,633	3	6		17
30	4,547		64,435		2,911	7	2,334	5,848	2	10		4
31	68		79,869		1,497	3,316	859	5,766				
Totals	48,389	58	582,093	244,040	180,490	75,000	507,561	746,088	13,048	13,154	46,741	11,580
June Total				4,870								
Oct. Total												
Season Totals										8		32
									241,927	88,220	1,136,795	1,006,610

TABLE V
THE INDIAN CATCHES OF SOCKEYE SALMON BY DISTRICTS AND
THE VARIOUS AREAS WITHIN THESE DISTRICTS, 1951, 1955.

<i>District and Area</i>	1951		1955	
	<i>Catch</i>	<i>No. of Fishermen</i>	<i>Catch</i>	<i>No. of Fishermen</i>
HARRISON-BIRKENHEAD				
Skookumchuck and Douglas.....	1,154	—	445	10
Birkenhead River.....	11,814	—	3,041	27
TOTALS.....	12,968	—	3,486	37
LOWER FRASER				
Laidlaw to Vedder River.....	—	—	1,895	
Seabird Island and Adjacent Area.....	620	30	4,910	
Katz and Ruby Creek.....	700	14	790	
TOTALS.....	1,320	44	7,595	190*
CANYON				
Union and American Bars.....	1,046	—	622	
Yale.....	5,014	—	4,851	
Spuzzum.....	1,833	—	637	
Upper Gorge.....	800	—	—	
Boston Bar.....	—	—	859	
Boothroyd.....	1,166	—	1,625	
Cisco.....	2,710	—	3,446	
TOTALS.....	12,569	—	12,040	225*
LYTTON-LILLOOET				
Gates Creek.....	5,805	44	6,053	
TOTALS.....	5,805	44	6,053	58*
BRIDGE RIVER RAPIDS				
Lillooet.....	5,590	36		
Rapids.....	9,130	62		
Pavillion.....	4,025	22		
TOTALS.....	18,745	120	12,947	126*
CHILCOTIN				
Farwell Canyon.....	362	12	522	
Hance's Canyon.....	375	9	687	
Alexis Creek.....	358	8	1,091	
Siwash Bridge.....	3,224	38	4,006	
Keighley Holes.....	240	4	533	
TOTALS.....	4,559	71	6,839	68*
UPPER FRASER				
Shelley.....	210	13*	130	
Alkali and Canoe Creek.....	400	—	750	
Chimney Creek.....	1,117	—	2,204	
Soda Creek.....	305	—	345	
Alexandria.....	150	—	193	
Quesnel.....	290	—	425	
TOTALS.....	2,472	—	4,047	79*
NECHAKO				
Nautley Reserve.....	1,777	7	879	8
Stella Reserve.....	2,072	8	670	7
TOTALS.....	3,849	15	1,549	15
STUART				
Fort St. James.....	1,694	27	589	25
Tachie Reserve and Pinchi.....	1,100	20	776	16
Trembleur Lake and Takla Lake.....	278	2	0	0
TOTALS.....	3,072	49	1,365	41
THOMPSON				
Nicomen Creek.....			6,480	
Ashcroft.....	1,385	—		
Deadman's Creek.....	850	15	2,124	
North Thompson River.....	450	6	302	
South Thompson River.....	10,261	35	803	
TOTALS.....	12,946		9,709	210*
GRAND TOTALS.....	78,305		65,630	

* Number of Permits issued to Indians in District.

The Indian catch statistics detailed above are obtained principally from the Fisheries Inspectors of the Canadian Department of Fisheries. These inspectors control the taking of sockeye for food by the various Indian populations residing throughout the Fraser River Watershed.

increasingly evident that weekend closed seasons are not the answer to the problem of regulating two separately-located and highly-efficient national fisheries. One of the two fishing areas must be rigidly controlled during the time that the other is being fished if proper racial escapements and equality in the catches of the two countries are to be guaranteed. This problem is most acute during August when the sockeye runs start delaying off the mouth of the Fraser River and are particularly susceptible to the newly-developed nylon gill nets.

The Canadian fishery took 42.71 per cent of the seasonal run because of the effective Sooke-San Juan fishery and because the August run of sockeye intermingled with the sizable pink salmon run and was thus uncontrollable by independent regulation. The Sooke-San Juan fishery reached an estimated daily efficiency of 50 per cent and the Fraser River gill net continued at its normal daily efficiency of 98 per cent.

A detailed record of the cycle-year catches of sockeye in Canadian Convention waters is presented in Table IV.

ESCAPEMENT

The 1955 run of sockeye to the Fraser River System totalled 2,595,000 fish of which 379,185 sockeye, 14.61 per cent of the total run, were recorded on the spawning grounds (Table VI). The total 1955 escapement represented a decline of 38.57 per cent over that recorded in the previous cycle year of 1951 and is considered the first unsatisfactory seasonal escapement since the Commission started controlling the fishery in 1946. Three factors together with a 17 per cent cyclical decline in the run contributed to the poor escapement. The increased efficiency and size of the Canadian Sooke-San Juan fishing fleet contributed to overfishing of the Stellako, Birkenhead, and Adams River runs. The numerical increase in the United States gill net fleet resulted in excessive fishing on the early runs, including those to Pitt and Bowron Rivers. The overlapping of the pink salmon with the Birkenhead and late Adams runs and the delaying at the mouth of the Fraser River characteristic of the migration of these races made it impractical to reduce the fishery further than was required for the protection of pink salmon.

The disastrous economic results of a below-minimum escapement is best indicated by estimating the effect of such an escapement on returning runs. The estimated required minimum escapement to Adams River on this cycle is approximately 150,000 sockeye; since only 64,000 fish were recorded at Adams River this run is expected to produce 500,000 fewer adult fish in 1959 than the area is capable of producing. When the effect of the other below-minimum escapements are considered the 1959 run is expected to fall short of its capabilities by at least 750,000 sockeye, irrespective of whether the total 1959 run is smaller than, equal to, or larger than the 1955 run.

The Chilko and Adams River runs produced approximately 50 per cent of the total 1955 population as was predicted but from knowledge of the number of seaward migrants the sea survival-rate of the two runs was calculated to be

only 5 per cent. More than 12,000,000 yearling migrants from Chilko Lake returned a calculated run of only approximately 625,000 sockeye and the total Adams River run was also calculated to be just over 600,000 sockeye, so that each area contributed to the season's population on a fairly equal basis. The escapement to Chilko was 128,081 fish or about 21 per cent of the run, which represents a satisfactory situation for future expectations. The Adams-Little River escapement of 64,000 fish was about 10 per cent of the total run or 43 per cent of the estimated required minimum.

Since the late runs destined for the lower-river spawning areas were heavily protected by fishing closures designed for the protection of pink salmon in the Fraser River area their escapements were adequate. The escapements of other races were generally low because of heavy fishing pressure and the 17 per cent decline in the seasonal population.

The total 1955 run is estimated to have exceeded the 1911 run in size and is considered to have been the second largest run on this cycle since 1903. The potential size of the run was definitely larger than the actual and this decline is believed to have been caused by sub-normal ocean survival. The occurrence of a sub-normal run causes a dangerous situation as the required sizes of individual racial escapements are fixed independently of the size of the run. Variations in run size are unavoidable but, regardless of the management difficulties involved in such a situation, the Commission is obligated to accomplish the almost impossible task of dividing the allowable catch between the fishermen of the two countries while still permitting variable racial escapements that are individually fixed in numbers regardless of the size of the total run. An absolute necessity for accomplishing this task is a relatively stable fishery that is reasonably controlled as to size, efficiency and fishing area. A relatively stable fishery such as defined has not existed for several years and 1955 was probably the most unstable fishery in recent years. The results of the changes in the fishing of both countries have already been described and the future economic loss due to overfishing in 1955 will be great. The overall efficiency of the fishing fleet combined with extended areas of operation are each year making the weekly closed seasons of less and less value for obtaining proper racial escapements. It is becoming increasingly obvious that the fishermen of each country may have to be restricted to one major fishing area at any one time, pending the development of a more desirable method of controlling the fishery if such a method can be found.

The 17 per cent decline believed to have been caused by a sub-normal ocean survival was not the only adverse natural factor affecting the 1955 run. A delayed peak runoff in the Fraser River created, near Yale, B.C., a six-day block to the upstream migration of the early runs of sockeye. The Early Stuart run was almost annihilated by this block with only 2,170 sockeye reaching the spawning grounds out of an estimated escapement from the fishery of between thirty and thirty-five thousand fish. The fish that did arrive were late, badly bruised and in poor condition to spawn. Once again, as in the years preceding the Hell's Gate fishways, sockeye drifted downstream and ascended creeks near Hope, B.C. Sockeye positively identified from scales as being of Early Stuart

TABLE VI
SUMMARY OF THE SOCKEYE ESCAPEMENT TO THE FRASER
RIVER SPAWNING AREAS, 1943, 1947, 1951, 1955

District and Streams	Period of Peak Spawning	Estimated Number of Sockeye				Jacks	Sex Ratio	
		1943	1947	1951	1955		Males	Females
							4-5 yr.	4-5 yr.
LOWER FRASER								
Cultus Lake.....	Nov. 20-25	11,875	8,898	13,143	26,000	78	7,990	17,932
Upper Pitt River.....	Sept. 10-17	Present	90,000	37,837	17,552	0	6,898	10,654
Widgeon Slough.....		293	750	745	—	—	—	—
HARRISON								
Big Silver Creek.....		Present	—	200	191	—	—	—
Harrison River.....	Nov. 16-20	1,114+	16,000	17,145	5,595	0	2,183	3,412
Weaver Creek.....	Oct. 19-21	3,128	6,500	12,979	21,330	66	7,791	13,473
LILLOOET								
Birkenhead River.....	Sept. 23-25	50,668	120,000	55,862	25,355	9,897	5,028	10,430
SETON-ANDERSON								
Gates Creek.....	Sept. 1-6	—	—	—	86	—	—	—
Portage Creek.....	Oct. 15-20	—	50	30	43	—	—	—
SOUTH THOMPSON								
Seymour River.....	Aug. 26-30	Present	10,000	24,344	9,511	42	3,881	5,588
Lower Adams River.....	Oct. 18-22	10,000	185,000	135,000	54,405	375	17,948	36,082
Little River.....	Oct. 15-20	Present	15,000	9,690	9,072	367	3,360	5,345
South Thompson River.....		—	100	500	0	0	0	0
Lower Shuswap River.....		—	0	0	23	—	—	—
NORTH THOMPSON								
Raft River.....	Aug. 29-Sept. 1	4,000	8,000	8,561	5,364	3	2,017	3,344
Barriere River.....	Sept. 1-3	—	—	108	103	0	50	53
CHILCOTIN								
Chilko River.....	Sept. 23-25	13,546	55,000	118,110	128,081	10,310	46,084	71,687
Taseko Lake.....	Aug. 31-Sept. 4	—	—	500	4,400	0	1,584	2,816
QUESNEL								
Horsefly River.....		—	6	51	62	—	—	—
NECHAKO								
Endako River.....	Sept. 2-4	46	450	742	594	0	177	417
Nadina River.....	Aug. 29-30	—	90	326	202	4	57	141
Nithi River.....	Aug. 24-31	—	60	90	79	0	34	45
Ormonde Creek.....	Aug. 29-31	—	40	120	27	1	13	13
Stellako River.....	Sept. 23-26	9,142	55,000	96,200	51,971	7	20,261	31,703
STUART								
Early Runs								
Driftwood River.....		—	0	50	0	0	0	0
Forfar Creek.....	Aug. 11-13	400	1,500	13,600	68	2	33	33
Frypan Creek.....		—	—	50	0	0	0	0
Gluske Creek.....	Aug. 11-19	—	200	3,787	99	0	54	45
Kynoch Creek.....	Aug. 11-13	2,150	10,000	32,825	1,029	5	306	718
Narrows Creek.....	Aug. 14-18	5	0	400	27	0	15	12
Rossette Creek.....	Aug. 10-13	450	2,500	10,000	916	4	268	644
Shale Creek.....		—	0	190	0	0	0	0
Misc. Streams.....		—	—	121	31			
Late Runs								
Kazchek Creek.....	Sept. 10-15	2	—	200	18	0	5	13
Middle River.....	Sept. 11-15	—	60	2,000	3,596	36	2,126	1,434
Tachie River.....	Sept. 15-20	—	—	100	4,000	0	2,000	2,000
NORTHEAST								
Upper Bowron River.....		6,215	23,945	21,770	9,355	5	4,285	5,065
TOTALS.....		113,034	609,149	617,376	379,185			

origin were found ascending Spuzzum, Seton, Texas, and Williams Lake Creeks several hundred miles from their natural spawning grounds. The early part of the Bowron run was similarly affected but the escapement which did reach Bowron Lake was in normal condition. As a result of this block it will be impossible to open the sockeye fishing season before at least July 15 in 1959 and some special restriction may also be required during early July in 1963.

When the 1955 block had been recorded and associated with definite water levels it was possible to analyze the rather obscure reports of earlier days to determine the possible frequency of such an occurrence. The last block of similar nature occurred in 1933 and was apparently responsible for the failure of the rather large early run of that year to reproduce in any numbers in 1937 or for any year on that cycle until 1945; this is the cycle year of the current large run which built up rapidly after 1945 as a result of the Hell's Gate fishways and early season closures on the fishery. It is extremely important that a means of passage be provided at the block location before the large 1957 run. A similar block occurring in that year would cost the industry at least \$2,500,000 before the run could be rehabilitated. This year's block alone will result in over \$400,000 being lost to the industry before the run can recover. Engineering surveys have been started and means of overcoming the obstruction will be determined in the spring of 1956. The cost of correcting the difficulty is considered to be low but careful studies must be made in order to provide a definite and positive method of correction.

THE 1956 CYCLE

The 1956 run should appear in the fishery in much the same daily order and magnitude as the 1952 run (see daily catch figures in Table VII and VIII), although some deviation from this pattern is shown to be possible by the daily catch of 1948, which had a second peak in early August. No appreciable catch can be expected in Puget Sound waters prior to July 20, about which time the earlier arrivals of the Chilko run and the Upper Pitt, Raft, and Seymour runs will enter the fishery. The main peak of the Chilko run has occurred at San Juan Islands between July 28 and August 2 in the past, usually to taper off fairly quickly and be supported by the much smaller Stellako run and the Birkenhead run which peaks about a week later in that fishing area. The middle and late August catches should be very low, especially in United States Convention waters.

One-half to two-thirds of the 1956 run will be composed of sockeye from the Chilko area; the size of the total run of the year therefore depends largely on the size of the Chilko population. The 1952 Chilko escapement (see Table IX) was considered to have approached the optimum size, there being perhaps more than the number of spawners required to fully utilize the spawning ground. The 1954 Chilko seaward migrants, which will become the returning adults of 1956, were calculated at between 25 million and 26 million. The seaward migrant run of 12 million in 1953 produced an adult run of about 600,000. The sea-survival rate of the 1955 Chilko adults was therefore about 5 per cent but this is thought to be lower than the average for the past four years. A more

normal survival rate would appear to be about 10 per cent. However, the effect of the period of restricted sea growth that reduced the return of 1955 adults may extend to the 1956 run and thereby reduce the survival rate to somewhere between 5 per cent and 10 per cent. The 1955 Chilko population of about 600,000 adults was preceded by a jack spawning run of 1,820 in 1954 and the 1956 run has been preceded by a jack escapement of 10,310 in 1955. A straight comparison yields an expected 1956 Chilko population of more than 3,000,000. On the basis of the 1955 survival rate a Chilko run of 1,250,000 can be expected but, on the basis of the comparative jack production in 1955, the 1956 run could approach 3,000,000. Probably neither of these estimates is correct and the true population size will be intermediate.

The 1952 escapement to Fraser River tributaries was distributed more evenly throughout the watershed than the larger 1948 escapement, and in general appeared to be satisfactory for reproduction. Other than Chilko there is no single population that will contribute abundantly to the 1956 fishery. Collectively, however, the Birkenhead, Upper Pitt and Stellako River runs will add materially to the season's catch. The Raft River run will probably be good within its population limitations. The mid-season catches will be supplemented to some extent by the small run to Silver Creek, tributary of Harrison Lake, and the small, but increasing, run to Gates Creek tributary to the Seton-Anderson System, which only appear on this cycle in any numbers.

Of the populations which migrate prior to the peak of Chilko, the Early Stuart and Bowron are the main contributors to the catch. The late-season catches will be supported almost entirely by Lower Fraser runs to Cultus Lake, Weaver Creek, and Harrison River Rapids because the late Adams population on this cycle is rigidly controlled at a low production level by quadrennial dominance. The size of the Cultus Lake population will depend on the sea-survival experienced by the 630,000 downstream migrants which were enumerated as they left the lake in 1954. The Weaver Creek spawning was not as effective as the number of 1952 spawners indicates; about one-third of the run died unspawned because extremely low water blocked their entry to the spawning beds, and judging from a comparison of the fry emergence with that of normal years, the fry survival of the remaining two-thirds was adversely affected by delay in spawning.

The 1952 total landing was 2,267,858 sockeye, constituting a pack of 230,452 full cases. The 1956 landing should be between 1,000,000 and 1,500,000 for each country but the case pack may be lower in relation to the number of fish than the 1952 pack. The 1952 fish were larger than the average for previous cycle years. The 1951 jacks preceding the 1952 run were larger than the 1954 jacks that preceded the small fish of 1955. The 1955 jacks preceding the 1956 run were about the same size as the 1954 jacks but the relationship between the size of jacks and the following year's returning adults may not be direct.

TABLE VII
DAILY CATCH OF SOCKEYE, 1940-1944-1948-1952 FROM UNITED STATES TREATY WATERS

Date	JULY				AUGUST				SEPTEMBER			
	1940	1944	1948	1952	1940	1944	1948	1952	1940	1944	1948	1952
1	31			5,011	48,139	58,863	118,062	40,805	1,063	26	2,707	714
2				8,640	47,299	46,797	100,423		199		391	598
3	26	4		7,943		28,550	97,469		329	49	1,150	433
4	1			4,857	29,215	20,117	67,360	32,815	507	44		435
5	18				36,386		60,695	25,891	805	65	1,297	140
6					57,375		68,962	16,978	419	55	3,799	
7		18			31,172	9,370		18,488	19	19	1,692	723
8		99		14,008		6,912			93	6	404	203
9	3			9,369	29,493	9,221	115,925		131		333	578
10	32	133		8,090	22,432	3,859	101,997		170	21	134	636
11	49	163		6,796	57	3,139	38,878		257	39		557
12	76	93		4,187	8,231	5,788	17,288	6,865	287	6	212	410
13	197	127			3,219			7,055	136		205	
14		150			4,652	1,855		2,697	2	20	65	434
15	2,006	241		9,159		2,272		2,712	305	2	15	299
16	7,149			10,812	4,764	383		2,831	203		42	272
17	3,751	1,490		13,794	3,329	1,242			187	28	140	193
18	8,014	1,292		16,876	380	935			463	28		202
19	14,083	2,669		11,786	1,717	423		4,096	175	3	233	151
20	15,731	3,836	1,900		3,057			3,143	93	5	88	
21	5	9,351	6,348		1,235	1,395		2,730		17	20	117
22	28,836	9,313	8,622	90,696	332	1,612	0	967	116	4	24	135
23	22,295	11,272	5,671	32,619	88	222	7	612	128		11	86
24	13,150	14,840	5,142	34,320	71	59		0	55	6	16	49
25	24,060	17,524		110,491	24	18			58	1		48
26	22,405	22,251		134,294	617	76		220		1	16	34
27	5,823	22,251			26			720	15	1		22
28	18,425	23,441			179	51		1,168	10	1		20
29	19,645	42,887		128,339	283	150		1,310		1	429	811
30	19,763	69,529		100,767	866	243		931	60		319	20
31	34,775	78,843		96,565	466	192			18			31
	43,488	56,431		56,664		17		655				
Totals	303,837	231,235	284,627	916,083	343,076	203,761	787,068	187,609	6,284	447	14,575	7,518
June Total				2,134								
Oct. Total									894		2,821	131
Season Totals									654,091	435,443	1,089,091	1,113,475

TABLE VIII
DAILY CATCH OF SOCKEYE, 1940-1944-1948-1952 FROM CANADIAN TREATY WATERS

Date	JULY				AUGUST				SEPTEMBER			
	1940	1944	1948	1952	1940	1944	1948	1952	1940	1944	1948	1952
1	129			10,225	30,779	98,603		11,392	4,880		2,149	13,562
2	142			8,532	1,132	91,273			2,474		2,757	5,599
3	197	218		12,241		89,969			2,134		15	3,343
4	409	228		1,184		69,713		811	1,813			6,475
5	526	328			119,969			108,955	1,011	1,813		10
6		396			44,468			36,472	983	2,689	2,830	
7		711		13,476	40,894	85,516		23,048	1,714		1,028	8
8	2,680			10,009	50,380	31,746		911	1,337		388	7
9	2,348			8,732	438	34,491			1,003		385	7
10	2,980	1,852		9,000		24,922		38,878	434	458	11	
11	4,103	1,360		1,317		22,513		12,321	764	413		11
12	6,249	1,572			19,920			11,433	8	284		12
13		2,286			11,063			9,381		576		
14		2,868		13,063		12,203		110				
15	15,718			8,249	9,428	5,933			1,621			28
16	10,262			13,221	7,448	8,641			610			28
17	13,403	5,119		22,896	9,507	8,117		17,786	519	3,018	3	27
18	14,781	5,722		11,729		13,438		9,714	635	3,175		17
19	15,465	5,486	1,281		22,711	9,424		6,218	5	1,567		17
20		5,058	1,281					5,443				
21		13,961	1,283	5,299	6,814	16,981						
22	38,682		637	5,299	7,872	4,696		67	10,059			
23	29,119			5,299	7,353	3,290			4,148			
24	33,497	45,821		39,207	6,804	2,535			2,021	5,574		1
25	35,661	22,035		48,841		80		21,489	2,021	1,232		1
26	1,584	18,488	2,912		5,479			9,583	1,660			
27		15,723	2,967		2,904			6,535				
28			16,769	211,103	1,754	9,138		5,162		5,523		2
29	85,214	12,229	11,248	109,483	785	1,632		13		488		2
30	32,359		23,567	79,096	1,200	1,275			3,365	704		
31	26,667	170,205		120,159		936					1,650	
Totals	372,175	331,666	61,945	767,660	409,102	633,627	633,653	335,722	39,671	26,765	34,511	29,157
May & June Totals	1,062	529	879	15,386								
Oct. & Nov. Totals									63,899	11,239	21,703	6,458
Unassigned as to date of catch									147,091			
Season Totals									1,033,000	1,003,826	752,691	1,154,383

TABLE IX
SUMMARY OF THE SOCKEYE ESCAPEMENT TO THE FRASER
RIVER SPAWNING AREAS, 1940, 1944, 1948, 1952.

District and Streams	Period of Peak Spawning	Estimated Number of Sockeye			
		1940	1944	1948	1952
LOWER FRASER					
Cultus Lake.....	Nov. 23-Dec. 1	74,121	14,200	13,086	18,910
Upper Pitt River.....	Sept. 8-13	Present	Present	53,000	48,887
Widgeon Slough.....	Nov. 15-20	—	1,050	—	1,648
HARRISON					
Big Silver Creek.....	Sept. 14-16	5,149	5,192	12,000	6,031
Harrison River.....	Nov. 13-18	11,000	73	26,000	25,794
Weaver Creek.....	Oct. 28-30	17,600	16,441	20,000	33,983
LILLOOET					
Birkenhead River.....	Sept. 25-30	27,320	57,707	120,000	79,082
SETON-ANDERSON					
Gates Creek.....	Aug. 26-Sept. 1	Present	—	—	6,883
SOUTH THOMPSON					
Seymour River.....	Aug. 19-21	600	200	4,000	6,785
Lower Adams River.....	Oct. 14-16	9,900	1,367	12,600	8,692
Little River.....	Oct. 10-17	1,700	200	2,400	1,964
Scotch Creek.....	Aug. 24-25	0	0	50	357
South Thompson River.....	Oct. 10-17	100	0	100	200
NORTH THOMPSON					
Raft River.....	Aug. 24-28	11,400	1,082	10,500	15,819
CHILCOTIN					
Chilko River.....	Sept. 21-23	300,000	328,655	670,000	489,473
Taseko Lake.....	Sept. 6-9	—	—	Present	3,647
QUESNEL					
Horsefly River.....	Aug. 26-Sept. 3	90	3	50	7,013
NECHAKO					
Endako River.....	Sept. 3-5	8	1	0	146
Nadina River.....	Aug. 23-28	—	—	30	1,677
Nithi River.....	—	—	—	1	45
Ormonde Creek.....	Aug. 23-27	36	15	150	996
Stellako River.....	Sept. 26-30	2,600	3,294	16,000	40,462
STUART					
Early Runs					
Driftwood River.....	—	—	—	—	38
Forfar Creek.....	Aug. 2-6	90	46	1,500	6,975
Gluske Creek.....	Aug. 1-6	0	—	1,500	5,911
Kynoch Creek.....	Aug. 1-5	195	350	7,500	13,439
Narrows Creek.....	Aug. 11-15	5	0	0	1,453
Rossette Creek.....	July 31-Aug. 5	0	2	1,500	3,575
Shale Creek.....	Aug. 11-15	—	—	0	414
Misc. Streams.....	Aug. 11-15	—	—	—	1,775
Late Runs					
Kazchek Creek.....	—	10	3	80	295
Middle River.....	—	300	22	200	476
Tachie River.....	—	—	—	20	364
NORTHEAST					
Upper Bowron River.....	Aug. 25-Sept. 5	4,625	1,700	25,218	18,672
TOTALS.....		466,849	431,603	997,485	851,881

— No observation.

REHABILITATION OF BARREN AREAS

Since 1949 the Commission has actively participated in transplantation experiments in efforts to establish new runs in what were once productive but are now barren areas. Two methods of transplantation, fingerling transplants and eyed-egg transplants, have been under observation. The year 1955 showed the results of the fingerling transplants carried out in the fall of 1952 in four different areas; these were described in the annual report for that year. Diligent observations in the commercial fishery and on the spawning grounds of Anstey River and Salmon River, where fingerlings of Seymour River origin were planted, failed to reveal any returns. Similarly the fingerlings of Adams River stock planted in Little Horsefly River and in Mabel Lake in the Upper Shuswap River drainage system failed to return as adults in 1955. As in all other fingerling transplants, extreme care was exercised in the selection of donor stocks, and in the incubation, rearing and planting of the fingerlings. The fingerlings appeared to be in excellent condition when released.

These four bring to a total of ten the number of experimental fingerling transplants carried out in the Fraser system. With the exception of the returns to the Quesnel Field Station in 1953, which were described in the Annual Reports for that year and for 1954, the returns from fingerling plants in general have been very unsatisfactory. However, the failure of fingerling transplantation to bring about the rebirth of runs to depleted areas did not preclude the testing and use of other methods.

In 1950 transplantations were made in Upper Adams River, and Portage Creek in the Seton-Anderson system, using "eyed-eggs". The details and results of these experiments were reported in the Annual Report for 1954. In 1954, in spite of heavy fishing, 205 adult sockeye returned to the *planted areas* in Upper Adams River, where no adult salmon had been observed for many years. The return of 3,505 adult salmon to Portage Creek in the same year provided further evidence of the value of "eyed-egg" plants in establishing new runs to barren areas.

Realizing the possible importance of this method of establishing runs in barren areas, in 1955 eggs were secured from Seymour River for planting in the Upper Adams River. The eggs were incubated to the "eyed" stage in a temporary station in the Seymour River drainage system and transported by air to the Upper Adams River. Approximately 780,000 eggs were planted from October 17 to October 19 in the site which gave such successful results in 1950. The water temperatures in Upper Adams River during the planting period varied from 42°F. to 46°F., which was comparable to the temperature of the Seymour River—the native stream.

A second artificial spawning ground was built at the Quesnel Field Station in 1955 and stocked with 100 sockeye and approximately 400,000 newly fertilized eggs flown in from the Stellako River. The new artificial spawning ground is 80 feet square with two duplicate sections each containing two types of gravel and two rates of flow. A grid of 1-inch-diameter perforated polythene pipes laid beneath the gravel provides continuous upwelling of temperature-

controlled, oxygen-saturated water to the eggs. The fish were permitted to spawn in any part of one section and showed a preference for the low flow portions of the bed. The fertilized eggs were planted in the other section. It is expected that improved flow conditions in all sections of the new artificial spawning ground will result in higher percentages of fry yield.

It is anticipated that the spawning-ground experiments may result in a biologically sound method of extending the sockeye populations of the Fraser River as required by the Sockeye Fisheries Convention. Artificial spawning grounds, if proven successful on an experimental basis, could be expanded on a large scale to supplement natural spawning grounds that do not meet the rearing capacity of their related lakes, and also to provide spawning grounds for lake rearing areas where none have ever existed.

WATERSHED PROTECTION

Population and industry continued to grow at a rapid rate within the watershed area during 1955, and new proposals were made for the development of large hydroelectric power dams. The fishery problems associated with the various water use projects required careful and in some cases extensive consideration by the Commission. The Department of Fisheries of Canada is vested with the legal authority for the protection of the commercial fishery in British Columbia and the Commission works in close cooperation with the Department in dealing with water use projects.

The Nechako River between Fort Fraser and the mouth of the Stuart River was again surveyed to determine if the reduced flows in the river caused by the Aluminum Company of Canada development were having any detrimental effect on sockeye. The discharge of the Nechako River at Vanderhoof was less than in 1953 and 1954 but spills from specially provided storage in Cheslatta Lake kept the discharge from falling below 1,000 cfs during the migration of the Stellako sockeye run.

Nechako River water temperatures during the migration period were slightly higher than in 1953 and a few days prior to the migration period they were higher than any recorded in the river during the five years it has been studied. Observations of the passage of the sockeye of the Fraser-Francois system were made periodically. No points of difficult passage were seen and there were no observed mortalities that might be attributed to high water temperatures.

Two meetings were held with the Aluminum Company to discuss proposed releases of water from the Skins Lake spillway and the Cheslatta Reservoir. The Company expected that the reservoir behind Kenney Dam would be full in June 1956 and desired to conduct test spills through the Cheslatta system. It also wished to gradually drain out the Cheslatta Reservoir in order to remove the dam in the fall of 1955. These proposals were agreed to with the provision that the Company would make available for fishery purposes the equivalent of 100 cfs continuous flow through the Skins Lake spillway. Removal of the Cheslatta storage dam was completed by October 24.

The Department of Fisheries of Canada was requested to provide informa-

tion relative to compliance with fishery laws which would assist the Department of Northern Affairs and National Resources in its study of the feasibility of a proposed power development scheme involving the Columbia, Thompson and Fraser Rivers. It was proposed to divert 10,000,000 acre-feet of water annually from the Columbia River into the Fraser River system and to use the water to develop power at a series of six low head dams on the Thompson River and four low head dams on the Fraser River. Supplementary storages totalling 6,500,000 acre-feet would be required on six of the major lakes of the Fraser River system, all of which support sockeye populations.

The Department of Fisheries requested the cooperation of the Commission in analysing the effects of the proposal on the fishery and in preparing preliminary plans of the necessary fish protective facilities. Over four months of intensive effort were required to collect the necessary information and prepare design criteria for the fish facilities. A joint report was then prepared for transmittal to the Department of Northern Affairs. This report concluded that, in spite of the provision of the best modern fish protective facilities, the construction of ten power dams on the Fraser and Thompson Rivers would preclude the preservation and extension of all the salmon runs to these rivers above the dams.

The Commission continued its research into methods of guiding downstream migrant sockeye. Experiments conducted at Sweltzer Creek in 1953 and 1954 indicated that a galvanotropic electric screen offered promise as a means of guiding migrants and this form of stimulus was selected for a prototype test at Baker Dam in the State of Washington. Full details of this test together with the experimental findings at Sweltzer Creek in the two previous years' research are contained in the Commission's Bulletin VIII. Because of the many limitations and practical problems involved, which could not have been anticipated from previous small scale experiments, the electric screen tested was found to be impractical at its present stage of development for protecting downstream migrant salmon at large dams. Further investigations are planned.

Construction of the Seton Creek power project of the B.C. Electric Company continued throughout the year. The diversion dam approximately one-half mile downstream from Seton Lake was substantially completed and the flow of the creek was diverted through the radial gate spillway on May 20. The project was visited by Commission and Department of Fisheries engineers early in July and arrangements made for raising the forebay elevation to permit operation of the fishway and its auxiliary water supply. The fishway successfully passed 129 sockeye to Gates and Portage Creeks, and the Department of Fisheries counted 8800 pink salmon passing through to reach spawning grounds upstream from the dam. The builders expect to have the power plant in operation by August 1956.

The Moran Power Development Limited placed before the Provincial Government a proposal for the construction of a high hydroelectric power dam on the Fraser River at Moran, about 20 miles upstream from Lillooet. The Provincial Government has required that this company obtain the approval

of the fisheries agencies concerned with the Fraser River salmon before the application for water licence will be considered. A preliminary meeting between representatives of the company and the various fisheries agencies, including the Commission, was held late in 1955.

A proposal to construct a brewery on the banks of the Nechako River at Prince George was carefully reviewed by the Commission. A preliminary report was prepared with recommendations for methods of handling the waste products and screening of possible water intakes. The Department of Fisheries and the Commission held technical meetings with representatives of the Company to discuss provisions for protecting salmon. Approval has not yet been given to the waste disposal facilities.

The waste disposal facilities provided at the Kamloops Oil Refinery continued to dispose of the refinery effluent without any overflow to the Thompson River. The company has given assurance that effluent will not be disposed of in the Thompson River if further development increases the quantity of effluent beyond the capacity of the present disposal facilities.

In conjunction with the development of uranium ore deposits a proposal has been made to construct an ore refining mill adjacent to the North Thompson River in the vicinity of Birch Island. Discussions were held with a representative of the development regarding methods of disposal of the mill wastes and a disposal system consisting of a settling basin for receiving mill slimes and liquid effluent and neutralization of the effluent and precipitation of objectionable chemicals has been approved.

Press reports disclosed plans of a chemical company to build a caustic soda and chlorine manufacturing plant in the District of North Vancouver on Burrard Inlet. Since it is believed that Burrard Inlet receives downstream migrant sockeye as well as other species of salmon, a meeting was arranged with the company to discuss problems connected with waste disposal from the plant. Details of the disposal system have yet to be worked out.

Laboratory investigations of the effect of silt on the incubation of sockeye eggs buried in gravel were concluded. This study was part of the overall assessment of the possible effects of placer mining operations on the spawning of sockeye and incubation of eggs in Horsefly River. A complete report on this investigation is being prepared.

After an investigation of the suitability of hydroelectric power sites on the Quesnel and Clearwater River systems as a power source for Prince George, the B.C. Power Commission has decided that the most economical source of power for Prince George would be a fuel burning plant using natural gas. The gas will be obtained from the pipe line from the Peace River area which will be built past Prince George next year.

Abnormal precipitation in the coastal region in November caused runoff of flood proportions in streams tributary to the lower reaches of the Fraser River. Spawning of sockeye in Weaver Creek and Upper Pitt River was complete at that time but it is believed that the excessive scouring of the stream

beds may have caused considerable loss of deposited eggs and the size of the affected races may be considerably less than normal in the 1959 cycle year.

The Weaver Lake siphon was operated this year for the first time since its construction in 1953. The additional water was required during the start of the sockeye run into Weaver Creek and because of it the fish gained access to the upper spawning areas without delay when water depths over the spawning grounds in the section of the creek above the confluence of Steelhead Creek dropped to only a few inches. Heavy rains eliminated the need for extra water during the rest of the spawning period.

A late peak runoff in the Fraser River in 1955 resulted in unusually high water levels during most of the sockeye migration period past Hell's Gate. From June 28 to July 3, the gauge level remained above 82 ft., which is unprecedented for this period in 42 years of record. Because of high water delays the first sockeye were not seen at Hell's Gate until July 12. Although the water level at that time was 4 feet above the upper operating limit of the fishways, fish were seen passing on the left bank above Hell's Gate and there was no indication of any obstruction to passage of fish. On July 20 the fishways became normally operative and the water stage remained above the lower operating levels of the fishways until well after the last sockeye for the year had been passed.

At Farwell Canyon, a slide occurred during the spring of the year in the fractured rock of the canyon wall above the right bank lower fishway. Large pieces of rock fell onto the deck gratings and partially filled the entrance bay of the fishway, but beyond a few bent grating bars, no apparent structural damage was done. However, this fishway, and the others, which were in normal condition, were in operation during passage of the Chilko run.

Extension of the Commission's private road from the Cariboo Highway to the Hell's Gate fishways was begun this year. The length of additional road required is 3200 feet of which 1400 feet of rough grade was constructed this year. By means of the foot trail down the hill a total of 5,083 highway travelers visited Hell's Gate during the season.

1955 PUBLICATIONS

1. Annual Report of the International Pacific Salmon Fisheries Commission for 1954.
2. Research Bulletin Number VII
The Chronological Order of Fraser River Sockeye Salmon During Migration, Spawning and Death, by S. R. Killick.
3. Research Bulletin Number VIII
An Investigation of the Problem of Guiding Downstream-Migrant Salmon at Dams, by F. J. Andrew, L. R. Kersey and P. C. Johnson.
4. A Report on the Fish Facilities and Fisheries Problems Related to the Fraser and Thompson River Dam Site Investigations, (Mimeographed). Prepared by the technical staffs of the Department of Fisheries of Canada and the International Pacific Salmon Fisheries Commission and issued by the Department of Fisheries of Canada.

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